(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1454   Roll No. | | | | | | | | | |

MCA

(SEMESTER-IV) THEORY EXAMINATION, 2012-13

THEORY OF AUTOMATA & FORMAL LANGUAGES

Time : 3 Hours]   *[Total Marks : 100*

SECTION – A

1.   Attempt **all** parts : $10 \times 2 = 20$

   (a)   Find a regular expression for the language of all strings over the alphabet {0, 1} that contain even number of 1s.

   (b)   "Every subset of a regular language is regular". State whether this statement is true or false with justification.

   (c)   Explain how to convert a regular expression into an NFA with epsilon moves.

   (d)   What is meant by an ambiguous grammar'?

   (e)   Explain meaning of the term 'recursive language'.

   (f)   Explain how a PDA that accepts by a final state can be converted to a PDA that accepts by an empty stack.

   (g)   Explain the concept of universal Turing Machine.

   (h)   Give examples of two context free languages whose intersection is not context free.

   (i)   If L_1 and L_2 are two regular languages determine whether the language $L_1 - L_2$ which consists of a set of strings in L_1 but not in L_2 is regular or not.

   (j)   Explain the term deterministic push down automata.

SECTION – B

2. Attempt any **three** parts : 3 × 10 = 30

(a) Draw a DFA for the following language over {0, 1}

L = {w | w contains at least two 0s and at most one 1}

(b) Describe a decision algorithm to answer the following question :

Given an FA M accepting a language L, and a string x, is x a prefix of an element of L ?

(c) Convert the following grammar into Chomsky Normal Form :

$S \rightarrow A \mid AB0 \mid A1A$

$A \rightarrow A0 \mid \in$

$B \rightarrow B1 \mid BC \mid \in$

$C \rightarrow CB \mid CA \mid 1B$

(d) Design a PDA that accepts the set of strings of 0's and 1's that have an equal number of 0's and 1's. Your solution should not consist of designing a grammar and then converting it to PDA.

(e) Show that a language L is recursive if and only if there is a Turing machine that enumerates L in canonical order.
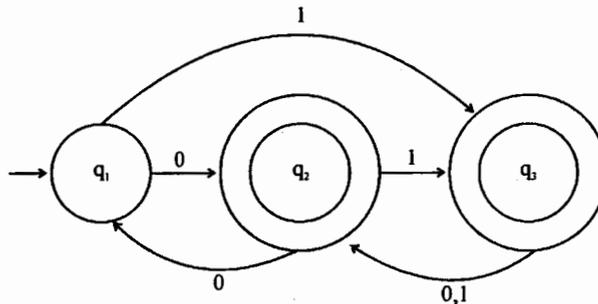
SECTION – C

Attempt **all** questions : 5 × 10 = 50

3. Consider the DFA M shown below. From this DFA construct a DFA M' which accepts strings that are reverse of the strings accepted by M.

$L(M') = \{x^r \mid x \in L(M)\}$

OR

For the regular expression (0*1)* over {0, 1} draw NFA- $\in$. Find a DFA corresponding to this NFA-$\in$.

4. Draw a DFA for the language consisting of set of strings over {0, 1} whose decimal value is divisible by 3. From this DFA find regular expression for the same language.

OR

Using Pumping Lemma show that the following language is not regular :

$L = \{0^i \mid i$ is a perfect cube$\}$

5. Design a context free grammar for the following language :

$L = \{a^i b^j c^k \mid i < j$ or $i > k\}$

OR

Given a context free grammar G give a decision algorithm to determine if a given string $x \in L(G)$.

6. Show that the halting problem of Turing Machines is undecidable.

OR

Show that the recursively enumerable languages are closed under the union operation.

7. Answer any **two** of the following : 2 × 5

   (a) Explain clearly the Chomsky Hierarchy.

   (b) Explain clearly the concept of undecidability of a problem.

   (c) Explain the procedure for minimization of a DFA.

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